AAM Ecosystem Working Groups
National Campaign Breakout 1

What are your overall thoughts on the NC Series top-level goals? Improvements to the current language? What is Missing?		
Objectives	**Improvements to the current language**	**What is missing**
Accelerate Certification and Approval: Establish initial requirements to inform vehicle certification, pilot licensing, and operational approval.	Establish rather than accelerate	Efficient certification and approval process
	Like second part of this objective	Expand cooperative surveillance requirements outside of ADS-B "out"
	Clarify if this also refers to ground infrastructure	Coordination with existing standards development organizations
	Verify that the plan is still to certify accordingly to part 23/27	Will there be certification for vertiports? Most likely updated AC guidance from existing heliports
	Remove the word "initial". Developed are farther along than this and can't let requirements keep moving during certification	Focus on special conditions from Part 23 for passenger carrying winged eVTOL
	I agree with this statement that pilot and vehicle certification needs must be identified quickly	Define classifications and phased approach for certifications
	Need to focus on levels of pilot certification	Certification under existing FARs?
	Consistency between FAA/EASA is important. Ambiguity is a bit of a problem at the moment	Initial requirements should include both rule and MOC
	Language to integrate acceleration without compromise	Minimum vehicle requirements are needed and this has been requested from NASA/FAA
	Consistency	Documentation of operational approval from FAA needs to be widely and publicly available to assist others in process
	Accelerate compared to what? There is no basis currently to compare against for aircraft like these	Pilot vs. operator vs. autonomous operations
	How would this be different from the Part 23 certification? Is overlap considered?	Guidelines and requirements
	NC-DT will end in 2021. Are you taking into account all the possible configurations of these aircrafts?	The goal is so general that it is difficult to change it. But noise is such a critical issue that it should be measured from NC-1 first scenario through the end
	Is the intent for this to be 3 separate activities or a combined certification approach?	Community acceptance/impact
	Take work "initial" out of SE	Focus on special conditions…

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Accelerate Certification and Approval: Establish initial requirements to inform vehicle certification, pilot licensing, and operational approval.	What FAR will govern?	Clear procedures for certification and approval (ATM)
	Eliminate the word "initial" - developers need to quickly have requirements that won't be shifting while they are in certification	All approvals should combine into one single entry point
	We should merge with land transportation because we are targeting one new ecosystem base on different assumptions and needs	Automated cockpit for self piloted vehicles
	Accelerate is the wrong word. It should be "integrate". As a member of ASTM F44 and F39, I cannot go any faster. But, we as a community can do a better job of integrating Eng'g Cert with Ops Cert and Pilot Licensing	Scoping for certification
	FAA to define vehicle separation standards	Is the role of the pilot "traditional" (i.e. Part 61)? Or, are we defining a new pilot requirement like in Simplified Vehicle Operations?
	Provisions for autonomous operations. Risk mitigations for AI onboard and decisions made in-flight, but AI systems	
	Integrate the certification across vehicle, pilot and operations	
	Importance of consistency with FAA and EASA	
	Coordinating with Singapore, South Korea, and Japan	
	Automation will end up "crossing the streams" in certification, pilot requirements and training, and operational approval. Can we acknowledge that up front? Should we?	
Develop Flight Procedure Guidelines: Demonstrate refined flight procedures and related airspace design criteria that address scalability and safety. Develop preliminary guidelines for vertiport designs and implementation.	Captures general purpose	Need autonomy?
	We have been using UAM Ports in our research. Maybe AAM Ports?	Related airspace design criteria that addresses scalability, safety, and integration with current ATM operations
	Community needs should drive vehicle type missions	Need to address shorter duration of flight and time to react as phases of flight are changed

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Develop Flight Procedure Guidelines: Demonstrate refined flight procedures and related airspace design criteria that address scalability and safety. Develop preliminary guidelines for vertiport designs and implementation.	Some vertiport design aspects go beyond flight procedures	For vertiport design guidelines, specify whether a new FAA advisory circular will be published or will the Heliport Design AC 150-5390-2 be modified to add eVTOL operations and facilities
	Timeline too long. Design cycles for these vehicles are short	Noise-efficient flight routes should be developed
	Seconding community needs - in addition to design guidelines, community outreach processes and collaboration with cities on vertiport and routing siting	Guideline for vertiport functions/requirements. Leave designs to architects and locals
	These aspects are more important than "guidelines", as these should be standards	Consider operations/dynamics of vertiport operations
	Fairness in airspace access	Vertiport design fully merged with actual footprint, avoiding redundancies
	Since this speaks to flight procedures, do we need to distinguish between vertiport infrastructure design and operations at vertiports?	Futuristic, but why not "flexible" or "movable" vertiports, smart, so to ensure their applicability where required
	Vertiport design guidelines are an entire area apart from flight procedures or airspace design criteria. Should this be separated out?	It would be important to consider different entities of the UAM ecosystem while developing guidelines. Here in EU, we are working on a similar approach to advance SORA and JARUS and mike it more applicable for scalable UAM operations
	The use of UML when NASA is using a Model Drive	Don't over spec "design", just spec requirements for vertiports
	Instead of UML to CML (capability maturity level)	Limited scope. The system should allow landing in backyards, parking lots, etc. This framework is an extension of a system that won't work for many applications
	Specifically require development of UAM flight procedure design standards (TERPS) for industry standardization	
	The FPG is the AAM equivalent of the 7110.65 series?	
	Incorporate considerations of off-nominal procedures	
	VFR vs. IFR operations	

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Develop Flight Procedure Guidelines: Demonstrate refined flight procedures and related airspace design criteria that address scalability and safety. Develop preliminary guidelines for vertiport designs and implementation.	VMC using VFR or IFR flight rules	
	e-vehicles, class A noise as default	
	This should show how it "integrates into the first objective	
	Brand new vertiports would delay the introduction. Need to leverage current buildings' rooftop plus parking zones	
	Noise and vibrations from the aircraft has to be studied. In an urban setting, there is harmonics. Mitigation steps must be considered with a design approach	
	Dave working a vertiport story	
	Demonstrate refined or revised flight…	
Evaluate the communication, navigation, and surveillance (CNS) Trade Space: Assess industry supported CNS technology to establish initial requirements.	Assess gaps in what technologies are supporting	It seems this is only focusing on existing technologies - it might be worth looking at what is coming down the pipeline
	Establish initial CNS requirements by evaluating existing CNS technology	Add "demonstrate the technologies"
	Verify that the plan is still to certify according to part 23/27	Spectrum allocation, especially for V2V and V2I
	What is meant by "Industry Supported"? Does this mean innovation coming from industry or only existing products?	Let's be careful to not have current performance drive requirements - needs operational basis instead
	Remove "initial"	Expand objective to include community safety
	A safety comms spectrum for UAM vehicles in cities. Do we need one?	Concerns, not just noise
	What is meant by "Trade Space"?	Specify any difference for piloted / remotely piloted / automated vehicles
	Are you planning mandatory systems in order to override pilots and manage emergency situations?	New capabilities are likely to be needed. Just assessing existing stuff is inadequate.
	Identify separation standards SE	Consideration for existing infrastructure (cellular?) and usability of that for comm / data exchange

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Evaluate the communication, navigation, and surveillance (CNS) Trade Space : Assess industry supported CNS technology to establish initial requirements.	Love the first clause; the second seems to suggest that we will base requirements on available or currently planned technology, which could be limiting or have risks.	How could you empower cities to develop and integrate different technologies and prepare cities to start business?
	Requirements must be based on ConOps and risk analyses	Sustainable business models
	Cannot do everything. Start within the constructs and constraints of the existing system. Use 400 ft. and below as a learning ecosystem for the NC Series	Humans as passengers only
	Align with ConOps development?	Large use of machine learning (AI) to control the entire ecosystem and automated protocols
	Engage stakeholders from the beginning (e.g. AOPA, who can either be a big thorn in the side of, or big proponent, of AAM)	Status of the art of best connectivity techs highly required incl. DATA management
	Unmanned operations + 5G as basics	
	There is still a high chance of getting "multi-path error" in urban environment. This needs to be reviewed with several experiments	
	This assumes non-Federal systems? If so, what are the liability questions? If Federal, how to integration to assure safety?	
	Establish initial requirements. "I" should be included	
	Autoland requirements for vertiports	
	Good objective	
Demonstrate an Airspace Management Architecture: Demonstrate and document a refined airspace system architecture capable of safely and reliably managing scalable AAM operations without burdening the current air traffic management system.	Synergize with current air traffic management rather than burdening	What does "Demonstrate" mean?
	Enhance or improve system overall	How high fidelity?
	Airspace Management Architecture is locality specific due to close proximity to population and local activities at very low altitudes	Once underway, AAM ops will quickly overwhelm the existing ATM (human-based infrastructure). Much discussion needs to take place to migrate ATM forward
	A copy of the current language on airspace architecture would be great. Please sent to David@embraerx.com	Integration with existing airspace must occur at some point, even if simulated

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Demonstrate an Airspace Management Architecture: Demonstrate and document a refined airspace system architecture capable of safely and reliably managing scalable AAM operations without burdening the current air traffic management system.	It would be interesting to understand what a valid "demonstration" process would be	Do we aim to avoid voice based ATC here? Or, will we start with current (not scalable) ATM procedures?
	Ensure AAM definition is broadened to include regional operations; does not have to be exclusive or outside of current operational scenarios	Needs to address the initial hybrid VFR/IFR operation in VFR conditions that then transition to IFR conditions on system maturity
	Is the objective to not burden or to be efficiently interoperable with existing ATM?	Is the airspace architecture here defined in relation to NAS?
	Replace "burdening" with…	It would be helpful for NASA to have one database for industry to have all the information overlap from NASA, FAA, etc.
	Capable of integrating with the current ATM	Expanding current ADS-B mandate to integrate all aircraft moving forward
	Include integration with current ATM	Expansion of current ADS-B mandate
	Does "without burdening current ATM system" mean that this is yet another independent system?	Align with current standards bodies (ASTM for example)
	It would be impossible not to burden the current ATM system. Best we can do is successfully integrate with appropriate investments in technology and staffing	Consideration for interactions during off-nominal or adverse weather conditions
	"Without burdening the current ATC system" may be an impossible goal given volume and proximity to major airports	Looking into automotive V2X might make sense too, due to ground level infrastructure
	Should UAM vehicles be on ATC scopes? What are the implications? So not want to limit industry or services that can be provided	Zonation and dedicated flight corridors that can be dynamically changed as per demand
	Management by exception is the path forward and any new entrant burdens the system so that wording is in question	Standards development for DAA
	Reliably managing scalable UAM operations while smoothly integrating with current ATM system	Current air traffic is part of the past. Here we will renovate the basic reasons to move and travel, also considering the boost of smart working and digital means

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Demonstrate an Airspace Management Architecture: Demonstrate and document a refined airspace system architecture capable of safely and reliably managing scalable AAM operations without burdening the current air traffic management system.	The Europe has U-space architecture and several demonstrations were made over the last couple of years. Some of them can be directly translated to AAM initiatives	No reference to a system-of-systems methodology required to address…without burdening the current ATMs
	So, is there thinking about how to integrate?	Goals should be "seamless integration with current ATM"
	Should be a multi-layer job. We should segregate into "spatial areas" not contaminating each other at the very beginning, otherwise, it will not move on	
	RNP accuracies and a phased approach that is achievable in the near-term	
	Define "burdening the current air management system". How much impact is considered a "burden"?	
	"Without burdening" is vague and ambiguous	
	First, define a refined airspace system architecture… (before demonstrate and document)	
Characterize Community Considerations: Conduct expanded characterization and initial impact assessment of passenger and community considerations through community feedback and measurements such as vehicle ground noise, cabin noise, and on-board ride quality.	A stakeholder engagement plan for each city UAM operations must exist to ensure a future for this movement. Suggest Chamber of Commerce connect with other countries to learn what is working abroad as well	Vertiport customer experience
	Intermodally	Ability of air taxi operations to create jobs and value to the communities and neighborhood
	Safety for passengers PLUS safety for non-passengers	Waste management of potential turnaround operations
	Separate passenger acceptance from community acceptance. They are different	intermodally
	Maximize travel choice as it may not always be from a vertiport	Operational proximity to buildings/people
	The language does not address other issues beyond noise, such as safest and land use impacts	Any consideration regarding the frequency and spacing of flights
	Characterize community AND municipality	Need to ensure ease of access. How to ensure "File & Fly" or walk-up requests

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Characterize Community Considerations: Conduct expanded characterization and initial impact assessment of passenger and community considerations through community feedback and measurements such as vehicle ground noise, cabin noise, and on-board ride quality.	Have noise standards already been established? Or, will those have to be determined?	Is there an approval process for landing locations?
	Community considerations are much broader than these three categories. They need to include socioeconomic considerations, integration into the existing multimodal transportation systems, impact on businesses, and a broad understanding of the public benefit that AAM could provide	Community acceptance should consider visual "noise". People may not like seeing vehicles even if they cannot hear them
	Will the noise standard be absolute? Or, relative to other factors such as safety (i.e. louder but safer)?	Traffic concerns, accessibility, zoning issues, operational frequency challenges
	It would be difficult to develop a mass of very low level traffic due to safety assessments	I see ground noise, but what about in-flight noise?
	Environmental and noise considerations for every vertiport (treated like an airport)	As observed from the ground?
	Noise should be measured continuously not in just one scenario	Historically, airport land use compatibility has consisted of three main areas: Noise, Airspace (obstruction clearance/building height limits), and Safety. I only see noise addressed here. Need to address airspace clearance (for buildings around a new vertiport) and Safety (location of flight paths, statistically likely accident zones)
	May want to include "visual noise" or visual clutter	Is anyone thinking about unintended consequences? The "unknown, unknowns"?
	Community is also about suppliers. Don't forget some may not agree or push back. Need to find a common benefit	Suggestion: vehicle noise must be measured from the first scenario in NC1 to the last scenario in the last NC. That provides a baseline such that noise decreases can be measured
	Considering the vertical supply chain of the ecosystem would be critical	Strategy to build trust - public acceptance and social embracement
	Privacy considerations with AI and AAM	Actual benefits shall be described, as per Starr's charts some time ago, incl. numbers
	Digital versus community privacy	Avoid discussing if no POC in place (augmented reality as main tool)

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Characterize Community Considerations: Conduct expanded characterization and initial impact assessment of passenger and community considerations through community feedback and measurements such as vehicle ground noise, cabin noise, and on-board ride quality.	Citizens concerns about getting in this new technology given how unpredictable/unreliable many of today's technologies already are	Numbers would be good. I saw one company state that they expect their vehicle MFRS to be 5db lower than current FAR36 requirements for community
	Emphasize benefits	What are community expectations in terms of noise?
	Promote $$ benefits, especially to corporate interests	How to involve communities in the decision process?
	Properly set expectations and amend them as the technology evolves	NASA, FAA, and other agencies should encourage manufacturers, operators, etc. to acknowledge and accept blame when something does go wrong (rather than finger point)/ This will encourage confidence in the entire system
		Manufacturers, to the extent they can, should make the vehicles or at least the taxi-rides, affordable, even if they experience initial loss
		Residential privacy can be a concern too
		Yeah, most of objective description is passenger vs. resident
		Doesn't address non-passenger AAM impact on community
Other	Communities will "make" or "break" the case for AAM/UAM. They need to be a part of the integration from day one	Recommendations on multi-user ground infrastructure (public access vertiports not controlled by a manufacturer)
	Fair assessment of community acceptance has to include the notion of perceived benefit which can be extremely subjective from one community to another, measure noise and comfort is not enough. Surveys and when available manned flights are an important first steps	Don’t forget UAS operations to/from conventional airports and integration with manned traffic in that environment
	Suggest using "Community-based" language for feedback when soliciting public input (noise, visual, pollution)	Messaging and education included in any of the objectives?

Other	Min. viable requirements so people don’t spend a lot of money building a vehicle that won't work	To develop a mass use of this technology in high density urban areas, it will be necessary to consider very strong safety objectives. The safety objective used in design and development will impact the number of how many aircraft could fly in a specific area

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What are your overall thoughts of the NC series timeline?			
Place the technologies listed in the correct timeline. Add numbers only in columns.			
NC - 1	**NC - 2**	**NC - 3**	**NC - 4**
25	1a	10	9
5	2	11	10
3	9	13	11
4	10	16	12
17	11	18	2
16	18	7	16
15	19	19	21
24	22	6	22
12	23	1a	20
21	1	1b	8
14	13	25	23
6	14	20	5
22	16	8	24
13	7	2b	17
11	25	21	1
19	5	14	19
1	8	15	25
7	15	12	3
2	17	9	4
1a	3	3	14
1b	1b	17	15
	2a	23	
	20		
	6		
	4		
	21		
	24		
	12		
	21		

1.CNS Technologies
    a) Vehicle
    b) Airspace
2.Procedural leg library
    a) Absolute and relative
    b) Performance-based
3.Category A takeoff & landing procedures
4.UAM Vehicle Standards
5.DAA airborne and surface based
6.Aircraft – airspace interactions and interfaces
7.Aircraft-based merging and spacing validating 4d clearance without loss of separation
8.Adaptive trajectory planning
9.Full envelope autopilot
10.Automated contingency planning
11.Automated arrival, approach and departure procedures
12.Hazard perception and avoidance
13.Benchmark & demonstration nominal operations
14.Recovery from disruptions
15.Emergency procedures
16.Heliport/Vertiport configuration management (e.g. obstacles, winds, spacing, bandwidth)
17.Noise/annoyance assessment
18.Scalable prototype network in relevant environment
19.Interoperation with traditional traffic and ATM
20.Key attributes of UML-4 demonstrated, path to completing requirements and standards
21.Validated system architecture including major subsystems and interfaces
22.Operational evaluation across design conditions
23. Maintain efficiency with local disruptions
24.Safety/resilience in presence of systemic disruption
25.Community impact

Place numbers in either category, or add your own words.	
Drop	Delegate
	25

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What are your overall thoughts of the NC series timeline?			
What technologies are missing? Add suggested scenarios and contingencies.			
NC - 1	**NC - 2**	**NC - 3**	**NC - 4**
Certification standards for UAM vehicle enabling technologies	Traffic management using swarm technologies	Certification of ML G&CS	Timeline may be too aggressive
What technologies will be used to integrate UAM into NAS; UTM?	Radar system for UAM		More time may be needed to gain confidence in performance/behavior
Uber has stated an aggressive time table to be in service and operational in DFW, LAX, and Melbourne (~2023). Obviously, safety is paramount, so governing agencies will not let this happen without due process. Will Uber influence any of the NC timetables?	V2V mesh networks		
AI/ML guidance and control systems			
Weather sensing (even for "clear weather" demonstrations)			
Life-cycle costs			

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Is there an alternative approach that you would recommend for the series?
We would like to see a space where we can propose our different airspace integration architecture, which is different than the traditional one

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